PATENT SPECIFICATION (11) 1 587 715

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(21) Application No. 13597/76 (22) Filed 3 April 1976 (19)

(23) Complete Specification filed 4 July 1977

(44) Complete Specification published 8 April 1981

(51) INT. CL.³ B65H 39/075

(52) Index at acceptance

B8R 652 664 671 681

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(54) ARTICLE HANDLING APPARATUS

(71) We, METAL BOX LIMITED, of Queens House, Forbury Road, Reading RG1 3JH, Berkshire, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to article handling apparatus. In particular, but not exclusively, the invention concerns a method and apparatus for feeding to a packaging machine a single stream of articles derived from several streams individually produced by a pluarality of further machines by which the articles are made and/or processed.

According to one aspect of the present invention, there is provided a method of forming a single stream from articles moving randomly but at the same speed in a predetermined number of parallel streams greater than one, which comprises:

operating upon the articles within the streams so as to accelerate them in succession to a speed greater than the product of the said speed and the said number of streams and in such relative time relation as to provide at least a clearance between them longitudinally of their paths of advance, and forming the accelerated articles into a single stream by lateral movement across their paths of advance.

Another aspect of the invention features an article handling apparatus for forming a single stream from articles arriving randomly but at the same forward speed in a pre-determined number of parallel streams greater than one, which comprises, for each incoming stream, an article advancing device operable to successively advance the articles in the stream to a speed greater than the product of the said forward speed to the said predetermined number of incoming streams, the advancing devices being arranged as a group in side-by-side relation across the paths of advance of the articles in the incoming streams, and the apparatus further including control means arranged for controlling the advancing devices individually but in such relative time relation that the articles leave the group of advancing devices separated longitudinally of their paths of advance at least by a clearance conveyor means arranged for receiving the articles leaving the advancing devices and for transporting them away from the same, and marshalling means operable upon the articles when transported by the conveyor means so as by lateral movement to form the articles into a single stream.

Aspects and features of the invention will become apparent from the following description, given by way of example and with reference to the accompanying drawings, of an apparatus embodying the invention. In the drawings:—

Fig. 1 is a schematic plan view showing the general layout of the apparatus;

Fig. 2 shows one of the fin seal pouches which the apparatus is designed to handle;

Fig. 3 is an enlarged plan view of a part of the apparatus as depicted in Fig. 1, showing the associated peripheral equipment provided for control and energization;

Fig. 4 is a simplified side elevation showing the upstream end of the part of the apparatus shown in Fig. 3;

Fig. 5 shows a detail of the part of the apparatus shown in Fig. 3, as seen on a transverse cross-section of the apparatus;

Fig. 6 is a view similar to Fig. 5 showing a modification;

Fig. 7 shows the modification of Fig. 6 in a like view to Fig. 4;

Fig. 8 is a simplified side elevation showing a further part of the apparatus than is shown in Figs. 3 to 7;

Fig. 9 illustrates successive stages in the operation of the part of the apparatus shown in Fig. 8;

Fig. 10 is a schematic side elevation of a further part of the apparatus;

Fig. 11 is a view similar to Fig. 10 and showing a modification; and

Fig. 12 is a schematic elevation of the modification of Fig. 11 as seen on a transverse cross-section.

Referring firstly to Figs. 1 and 2 of the

drawings, the apparatus embodying the invention has four substantially identical packaging machines 10 arranged to form and fill fin seal pouches 11 containing a product such as a petfood, and to pass the formed and filled pouches onto respective output conveyors 12.

Each pouch 11 is as shown in Fig. 2 and is conventional. It comprises two rectangular webs 15 of heat-sealable sheet material such as a polyethylene/paper laminate, which are superimposed on one another with the product 13 therebetween and are heat sealed together around the product so as to form a generally planar heat seal 14 extending around the median line of the pouch as seen in side elevation.

The machines 10 are operated independantly of one another at a nominal individual output of 90 pouches per minute. However, for various reasons the output of any particular machine may fall below this figure, and for the purposes of the following description it will be assumed that the pouches 11 on each conveyor 12 are randomly spaced but subject to a maximum flow rate of 90 pouches per minute.

The conveyors 12 feed the four inputs to a first marshalling station generally denoted 16. The two outputs of this station are fed as inputs to a second marshalling station 17 which combines them to form a single stream of pouches on a conveyor 18.

From the conveyor 18 the pouches pass onto a plaque divertor 19 which distributes them alternately to form two equal streams on a further conveyor 20. The conveyor 20 in turn feeds a group maker 21 which forms the two streams into groups of four pouches in 2 × 2 formation on a conveyor 22.

A transfer device (not shown in Fig. 1) picks the groups in turn off the conveyor 22 and transfers them to the input conveyor 23 of a carton forming and filling machine 24. As each group of pouches enters the machine 24 it is operated upon by a succession of pusher members generally denoted 25, which are effective to superimpose one row of the group upon the other. In this disposition the groups are side-loaded and sealed by the machine 24 into individual cartons 27 and thence are passed onto an output conveyor 26 for dispatch.

Of the parts of the apparatus described or mentioned above, those referenced 10, 12, 18 to 20 and 23 to 26 may be largely or wholly conventional and are therefore not described in detail. Typically the pouch forming and filling machines 10 are of the kind marketed by Hamac-Höller GmbH under the type designation BMA, the plaque divertor 19 is an "Autoscale Autovector" marketed by Best Electronics Limited, and the carton forming and filling machine 24 is of the kind marketed by Metal Box Limited under the type designation "Embeeseal".

The devices 23 to 26 are arranged to run in synchronism at a slightly greater throughput than the maximum nominal rate of 90 pouch groups per minute at the output conveyor 22 of the group maker 21. If for any reason the throughput of the devices 23 to 26 is exceeded by the throughput from the group maker, the excess of pouches from the group maker falls onto an overload conveyor 30 which takes it way for separate packing or later recirculation. The arrangement of this conveyor and the other non-conventional devices 16, 17 and 21 together with the transfer device previously mentioned will become apparent from the following description of those items to be given with reference to Figs. 3 to 12.

Referring firstly to Figs. 3 and 4, the first marshalling station 16 is shown in relation to the downstream end of the conveyors 12. It comprises four pairs of vertically opposed upper and lower rollers 31, 32 mounted on two vertically aligned horizontal shafts 33, 34, only the upper rollers 31 and upper shaft 33 being visible in Fig. 3. The shafts are continuously driven by a motor and gearbox combination 37 (Fig. 3) in opposite senses as indicated by the arrows in Fig. 4. The rollers 31, 32 are normally driven by means not shown at the speed of the conveyors 12. However, they are lockable to the shafts by means of clutches (not shown) with which they are individually provided, so as to be driven at the greater speed of the shafts as will later be described. The clutches are controllable in pairs, by means of two control systems 50A, 50B) of which the system 50A is arranged to selectively control the clutches of the upper two pairs of rollers 31, 32 as shown in Figs. 1 and 3, the system 50B being likewise arranged to to selectively control the clutches of the lower two pairs of rollers.

The rollers 31, 32 of each pair are provided with a suitable resilient and high friction facing (not shown). They are spaced apart to receive a pouch 11 from the respective conveyor 12 via a first idler or driven roller 43, and to pass the pouch through the nip between them and, via a second idler or driven roller 44, onto the upper run of a belt conveyor 36.

The conveyor 36, which, like the rollers 43, 44, serves for all four pairs of rollers 31, 32, circulates around upstream and downstream rollers 37, 38. It is continuously driven by means not shown at a speed which is slightly greater than twice the speed of the conveyors 12, for the purpose later to become apparent.

Two further belt conveyors are arranged above and on either side of the conveyor 36

so as to present vertical inner runs to pouches passing along the latter. The conveyors 39 are each circulated around vertical rollers 40, 41 at either end, at the same speed as the conveyor 36. They are convergent in the downstream direction.

A vertical spacer plate 42 (Fig. 3) is rigidly mounted to extend along the centreline of the conveyor 36 so as to keep separate the pouches emerging from the upper two pairs of rollers (Figs. 1, 3) on the one hand and those emerging from the lower two pairs of rollers on the other.

The control systems 50A, 50B, are identical and identically arranged in relation to their associated roller pairs so as differentially to control the clutches of the roller pairs. Each control system operates in response to sensing signals from sensing devices (unnumbered) which are individually associated with its roller pairs and each of which produces a sensing signal when the leading edge of a pouch 11 arrives at the nip between its roller pair. In Fig. 3 the sensing lines for transmitting the sensing signals from the sensing devices (e.g. photoelectric cells) to the control systems are referenced 53, and the control lines for transmitting the control signals from the control systems to the roller clutches are referenced 54.

As will now become apparent, each control system is arranged, in response to a sensing signal on one of its sensing lines 53 indicative of the arrival of a pouch at the respective roller pair, to close the clutches on that roller pair either immediately or with a delay, depending upon the spatial relationship of the pouch to the previous pouch to arrive at the other roller pair within the control of the control system.

If the sensing signal in question succeeds the previous sensing signal on the associated sensing line 53 by a time delay indicative of a pouch spacing on the conveyors 12 of exactly one half a pounch length, the control system immediately closes the clutches of the roller pair associated with the sensing signal in question, with the result that the pouch which initiated the sensing signal is substantially instantaneously accelerated by the motor/gearbox combination 37 to a speed which is slightly greater than twice the speed of the conveyors 12; the control system is then reset to prepare it for the next pouch to arrive on the two conveyors 12. The pouch in question and the preceding pouch are therefore provided with a small clearance in the longitudinal direction of conveyor 36 as they pass along this conveyor.

If the delay between the sensing signal in question and the previous sensing signal on the other sensing line 53 is indicative of a pouch spacing on the conveyors 12 of less than one half a pouch length, the control system closes the clutches of the roller pair after a time delay such that the small clearance between the pouch in question and the preceding pouch is again provided.

The time delay is initiated when the trailing edge of the preceding pouch leaves the nip of the roller pair accelerating it. By way of example, assuming that a pouch 11 is being accelerated through the top roller pair as shown in Fig. 3 after producing a sensing signal on the associated sensing line 53, and that the leading edge of a further pouch arrives at the second roller pair from the top when a time interval equivalent to a spacing of $\frac{1}{8}$ of a pouch length on the conveyors 12 has elapsed since the production of the sensing signal. In response to the sensing signal indicative of this further pouch the control system 50A will close the clutches of the second roller pair after a time interval equivalent to $\frac{3}{8}$ (i.e. $\frac{1}{2}-\frac{1}{8}$) of a pouch length (as referred to the conveyors 12) has elapsed subsequent to the time instant when the earlier pouch exits from the first roller pair. The latter instant of time may be determined directly, by sensing the trailing edge of the earlier pouch, or it may be determined by calculation using the sensing signal produced by the earlier pouch as dataum. After controlling the clutches of the second roller pair the control system is reset.

If two pouches arrive simultaneously at the roller pairs of a control system 50A or 50B, the control system gives priority to a preselected one of the roller pairs, say the upper one as shown in Figs. 1 and 3, the acceleration of other roller pair accordingly being delayed by slightly longer than the time equivalent of $\frac{1}{2}$ pouch length as referred to the conveyors 12.

Subsequent to a sensing signal on one of its associated lines 53 each control system 50A, 50B is reset unless a sensing signal arrives on the other line 53 within or equal to a time equivalent of $\frac{1}{2}$ pouch length (whereupon resetting is delayed until the control system has operated in response to the second sensing signal). Subject, therefore, to this proviso, a pouch arriving at any roller pair will be immediately accelerated through that roller pair irrespective of the position of the immediately preceding pouch within the control of the same control system.

From the foregoing is will be understood that the pouches 11 of the two streams passed onto the conveyor 36 from each two associated roller pairs will be in non-overlapping relation as seen transversely of the conveyor; at least they will be separated by a small clearance. This enables the two streams to be readily combined to form a single stream without the possibility of interference between their pouches. The combination of the two streams is effected while the streams are passing along the conveyor

36, by means of the appropriate one of the inclined belts 39 which forces the outer one of the streams progressively inwardly into alignment with the inner stream.

Fig. 5 illustrates the engagement of a pouch 11 of the outer stream with the inner run of the conveyor 39. It will be seen that the engagement occurs at the heat seal 14 of the pouch. If the pouch is of a readily deformable nature the arrangement shown in Figs. 6, 7 may be preferable. In those figures the single belt conveyor 39 of Fig. 5 is replaced by two belts 39A of circular cross-section circulating in parallel one above the other so as to receive the heat seal between their inner runs while they are pinched together by a rigidly mounted pinch member 47. The lateral forces exerted on the pouch are therefore transmitted to the relatively robust body of the pouch, rather than to the rather flaccid heat-seal 14. In order to ensure initial entry of the heat seal between the belts 39A the heat seal is first ploughed upwards above the median line of the pouch by a plough 45 mounted on the outer side of the roller pair 31, 32 a further plough 46 being provided at the entry to the belts 39A to return the heat seal to the median line for entry between the belts.

Referring again to Fig. 3, the second marshalling station 17 is arranged in a largely analogous manner to the first marshalling station except that it has two roller pairs 31^1, 32^1 instead of four. The rollers are normally driven at the speed of the conveyor 36 but are clutchable to common upper and lower shafts 33^1, 34^1 on which they are mounted in response to control signals on control lines 54^1. In Fig. 3 only the upper rollers 31^1 and upper shaft 33^1 are visible.

The control signals are generated by a single control system 50C which is identical to the control systems 50A, 50B of the first marshalling station and is likewise responsive to sensing signals received on sensing lines 53^1 from sensing devices (unnumbered) associated with the roller pairs.

The shafts 33^1, 34^1 are continuously rotated in the appropriate opposite directions by a motor/gearbox combination 37^1 which is arranged to drive them at slightly greater than twice the speed of the conveyor 36^1. The control system 50C operates to differentially control the roller pairs using exactly the same criteria as are used by the control systems 50A, 50B individually, with the result that the pouches in the two streams incoming on the conveyor 36^1 are provided with at least a small clearance between them (as seen in the transverse direction) as they emerge from the roller pairs.

From the roller pairs the pouches pass onto the upper run of a belt conveyor 36^1 moving at the same speed as the emerging pouches, and as they pass along this conveyor they are converged to form a single stream by opposed conveyors 39^1 which are equally inclined to the common centreline XX of the two marshalling stations 16, 17. The belt conveyors are arranged in the same manner as the corresponding conveyors of the first marshalling station, that is to say, they are either as shown in Fig. 5 or as shown in Figs. 6 and 7, depending upon the rigidity of the pouches 11 to be handled.

It will thus be understood that the two marshalling stations 16, 17 in combination form the four streams of pouches on the conveyors 12 into a single stream in which successive pouches are separated by at least a small clearance. This single stream, which moves at slightly greater than four times the speed of each conveyor 12, is passed from the conveyor 36^1 to the conveyor 18 circulating at the same speed, and thence into the plaque divertor 19.

After segregation by the plaque divertor into two equal streams on the conveyor 20, the pouches enter the group maker 21, the detailed arrangement of which is shown in Fig. 8.

Referring now to Fig. 8 in conjunction with Fig. 1, the group maker comprises two pairs of upper and lower rollers 60, 61, one pair for each incoming stream of pouches. The upper rollers 60 are journalled for rotation about a common horizontal and transverse axis; likewise the lower rollers 61 are rotatable about a further common, horizontal and transverse axis which is vertically aligned beneath the first axis.

Each roller 60, 61 is generally cylindrical but has two diametrically disposed rows of gating bulges 65 formed along its length. The rollers of each pair are coupled together and drivable in unison by a motor/gearbox combination (not shown) so as to perform discrete half revolutions in the direction indicated, each such half revolution beginning and ending with correspondence of rows of gating bulges 65 on its two rollers as shown in Fig. 8. The diameters and relative spacing of the rollers 60, 61 and the depth and shape of the gating bulges 65 are such that during substantially the whole of each half revolution the periphery of each roller of a roller pair can closely conform to a pouch passing between the rollers, including the heat seal 14 of the pouch. It will thus be seen that each roller pair is able with each half revolution to pass a pouch which enters its nip, the close conformity of the roller peripheries to the pouch throughout the half revolution ensuring that the emerging pouch has an accurately defined position.

Each pair of rollers 60, 61, has an associated control system (not shown). A sensing device (not shown) is mounted and arranged so as to produce a sensing signal

whenever the leading edge of a pouch 11 enters the nip defined between the rollers by the rows of gating bulges 65 which are in correspondence at the time. In response to each sensing signal the control system activates the motor/gearbox combination associated with the roller pair so that the rollers rotate through one half revolution and the pouch in question is gated through. The two roller pairs accordingly operate completely independantly of one another, on an "on demand" basis.

In addition to the two roller pairs and their associated control and drive arrangements the group maker 21 also comprises the output conveyor 22 previously mentioned. This serves for receiving the outputs of both roller pairs 60, 61 but takes its drive from one of the roller pairs only, the top roller pair as shown in Fig. 1 being assumed for the sake of example.

As shown, the conveyor 22 is arranged for circulation around end rollers 66, 67, having a length equal to twice the length of one pouch 11. The upstream end roller 66 is spaced from the two roller pairs by one pounch length, the gap between the rollers 66 and the roller pairs being bridged by the upper runs of two further conveyors 68. The conveyors 68 are opposed by similar conveyors 69 associated with the rollers 60.

Although not apparent from the drawings, it is to be understood that each conveyor 22, 68, 69 is formed of two or more strands, the strands of the conveyors 68, 69 being accommodated by spaces between the gating bulges 65 where they pass around the rollers 60, 61. Furthermore, whereas the one or more strands of the conveyors 68, 69 associated with the top roller pair (Fig. 1) are at all times drivably connected to the conveyor 22 through the agency of the roller 66, the strands of the conveyors 68, 69 associated with the lower roller pair are carried on sleeves or the like (not shown) which are rotatable on the body of the roller 66 so that no drive is effected to the conveyor 22 when the lower roller pair is operated. When the upper roller pair is operated, however, the conveyors 68, 69 of both roller pairs are arranged to be indexed forward together to achieve the forward movement of the conveyors of the lower roller pair, the latter may be arranged for drive either from the upper roller pair via the conveyor 22, or from the lower roller pair itself.

From the foregoing it will be understood that the group maker 21 operates as follows to form successive groups of four pouches in 2 × 2 formation from the pouches alternately provided by the two streams on the conveyor 20.

Reference will now be made to Fig. 9 which shows successive stages in the formation of a group. Let it be initially assumed that, as depicted in Fig. 9A, a group of pouches has already been formed on the conveyor 22, that the first pouch of the succeeding group has already been gated through the upper roller pair and is resting on the conveyor 68, and that the second pouch of the succeeding group is approaching the lower roller pair on the conveyor 20.

On arrival at the nip between the rollers of the lower roller pair, the second pouch causes the associated control system to actuate the lower roller pair and the pouch is gated through as described above to join the first pouch on the conveyor 68.

A third pouch thereafter arrives at the upper roller pair and is gated through in like manner. However, whereas the gating of the second pouch is not attended by any movement of the conveyor 22, the gating of the third pouch is attended by forward indexing movement of the conveyor 22 by one pouch length. As depicted in Fig. 9C, the first and second pouches therefore move onto the conveyor 22 to accommodate the third pouch on the conveyor 68,

It will be seen that the conveyor 22 is stationary during the time itnerval separating the gating of the first and third pouches onto the conveyor 68. During this time interval the transfer device previously mentioned picks the prevoiusly formed pouch group off the conveyor 22 and carries it beyond the downstream end of that conveyor for reassembling and packing as is to be described. Fig. 9B shows the group maker at the completion of the gating of the second pouch on to the conveyor 68; it also shows the back end of the preceding group as it is carried away by the transfer device.

Subsequent to the gating of the third pouch of the group through the upper pair of rollers as described above, the group is completed when the second pouch of the lower stream arrives at, and is gated through, the lower pair of rollers to join the third pouch on the conveyor 68. The position is then as shown in Fig. 9D.

Finally, the next pouch to arrive on the upper stream is gated through the upper rollers while the four pouches forming the group in question are indexed forwardly by one pouch length so as each to lie on the conveyor 22. The position is then again as shown in Fig. 9A, the newly gated pouch being the first of the next group subsequently to be formed by the same sequence as before.

Fig. 10 shows the general arrangement of the transfer device in relation to the group maker 21 on the left hand side, the input conveyor 23 to the carton forming and filling machine 24 on the right hand side, and upper run 81 of the overload conveyor 30 generally between and below those items.

The transfer device, generally denoted by the reference numeral 70, comprises a carriage 71 which is slidable along a rigidly mounted horizontal support 72 between a position—indicated by broken lines—at which it overlies the conveyor 22 and a variable position at which, as indicated in full lines, it overlies the upstream end of the conveyor 23. In this respect it is noted that the conveyors 22, 23 are longitudinally aligned with one another, and the carriage 71 is movable longitudinally between them.

The carriage 71 mounts a vertically slidable support rod 73 having a vacuum head assembly 74 attached to its bottom end. The assembly 74 has four vacuum heads 78 arranged in a 2 × 2 formation corresponding in plan to the arrangement of the pouches of a group on the group maker conveyor 22. The heads 78 are connectable to a source of reduced pressure (not shown) and are each capable, when so connected, of picking up a pouch 11 to which they are presented.

The input conveyor 23 to the carton forming and filling machine 24 is carried for continuous circulation about horizontal axes at either end, the axis at the upstream end only being shown and denoted by the reference numeral 75. It is aligned with the group maker conveyor 22.

Pouch receiving flat-bottomed trays 76 are mounted at regular intervals along the conveyor 23 in transversely aligned pairs. Each tray is arranged to receive the two pouches forming the aligned row of a group on the group maker conveyor 22. It has open sides but has inclined walls 77 at its ends to provide guidance for pouches falling into it as is later to be described. In order to enable it to negotiate the ends of the conveyor 23 each tray is formed in two separate halves, one per pouch, which are individually articulated to the conveyor so as to adopt generally horizontal attitudes when moving along the upper (and lower) runs of the same.

For the following description of the transfer device in operation it will be initially assumed that, as depicted in Fig. 10, the vacuum head assembly 74 carrying a group of pouches is located directly over the most upstream empty pair of trays 76 on the upper run of the conveyor 23, and that the group maker 21 is as depicted in Fig. 9A, that is to say, a further pouch group is at rest on the conveyor 22 having just been moved to that position by the gating through of the first pouch of the next group to be formed.

In response to a correlation signal indicative that the vacuum head assembly 74 is in position, the reduced pressure supply to the four vacuum heads 78 is removed, and the pouches of the group held by the vacuum heads drop into the tray pair beneath them and are carried away to the carton forming and filling machine 24.

Having released the first group of pouches in this way, the transfer device automatically operates to return the vacuum head assembly 74 at high speed to its position above the group maker conveyor 22. In response to a group indication signal derived from the group maker 21 by means not shown and indicative that the succeeding group of pouches is awaiting removal on the group maker conveyor 22, the vacuum head assembly is then lowered onto the pouches on the conveyor 22 by sliding movement of the support rod 73 in the carriage 71, the reduced pressure supply is reconnected to the vacuum heads 78, and vacuum head assembly is raised to pick the four pouches off the conveyor 22 and so vacate that conveyor for receipt of the first two pouches of the succeeding group as depicted in Fig. 9C.

After picking up the pouch group from the conveyor 22 the carriage 71 is moved downstream until it is located over the first empty tray pair available. A correlation signal indicative of this correspondence is then generated in response to which the reduced pressure supply to the vacuum heads is removed so that the pouches are allowed to drop into the empty tray pair. The sequence is then repeated for the next pouch group.

If desired, after location over the selected empty tray pair, the carriage 71 is for a short time moved in synchronism with the tray pair while release of the pouches takes place. This increases the accuracy with which the pouches fall into the tray pair, but it is hoped that the inclined walls 77 at the front and back of each tray will provide a sufficient accuracy of location to make this synchronised movement unnecessary. To even further increase the accuracy of location, the synchronised movement, if provided, may be accompanied by lowering of the vacuum head assembly 74.

Since, as previously stated, the carton forming and filling machine 24, and hence the conveyor 23, is operated at a slightly greater speed than that demanded by the maximum rate of formation of 90 pouch groups per minute on the group maker conveyor 22, occasional empty trays will in normal operation always occur on the conveyor 23 as it enters the machine 24. Assuming the maximum production rate of 90 pouches per minute at the group maker conveyor 22, the position at which successive groups of pouches are dropped into the trays 76 will move progressively downstream until a second empty tray pair becomes available at the upstream end of the conveyor 23 for the pouch releasing operation,

whereupon the dropping position returns upstream to meet this second empty tray pair and the downstream progression is repeated. If the output of the pouch maker drops below 90 pouches per minute, the dropping position is correspondingly adjusted so that the most upstream empty tray pair available is always used.

If for any reason and at any time, the rate of formation of pouch groups on the group maker conveyor 22 exceeds the available throughput of the conveyor 23, the excess of pouches falls off the end of the conveyor 22 and is guided by a guide plate 80 onto the upper run 81 of the overload conveyor 30. The conveyor 30 then carries them away for recirculation or manual packing.

The correlation signals mentioned above are generated by vertical alignment of light sources (not shown) individually mounted on the conveyor 23 beneath the pairs of trays 76 with a photocell (not shown) mounted on the vacuum head assembly 74.

Although not apparent from Fig. 1 or Fig. 10, the trays 76 on the lower half of the conveyor 23 as seen in Fig. 1 are arranged to support the pouches at a vertically higher level above the conveyor as seen. The difference in height is sufficient to enable the pouches in the trays of the lower conveyor half to be progressively pushed into overlying relation with the pouches carried by the upper conveyor half so that in each completed carton 27 emerging from the carton forming and packing machine 24 the pouch group within the carton is arranged as a single row two pouches in length and two in depth. As previously mentioned, the reassembly of each pouch group is achieved by the succession of pusher members 25 as the pouches enter the machine 24.

Figs. 11 and 12 show a modification of the apparatus in which the conveyors 22, 23 are disposed in side-by-side relation rather than being longitudinally aligned as previously described. Apart from the transfer device 70^1, now to be described, the various items forming the apparatus, in particular the group maker 21, the conveyor 23 and the overload conveyor 30 are individually as before and the same reference numerals are accordingly used.

The transfer device 70^1 of this modified apparatus has a chain conveyor formed of two spaced and endless chains 86 arranged for circulation in parallel above the side-by-side conveyors 22, 23, about two longitudinally directed and horizontally aligned axes 87.

Four horizontal supports corresponding to the support 72 of Fig. 10 and accordingly denoted 72^1 extend horizontally between the chains 86 at regular intervals along their length. Each support mounts a vacuum head assembly 74^1 by means of a carriage 71^1 slidable along hte support, and a support rod 73^1 vertically slidable in the carriage.

In operation the chains 86 are intermittently circulated by discrete movements of one quarter of their length in the direction indicated, on demand from the pouch groups successively formed on the group maker conveyor 22. Let it be assumed that a vacuum head assembly is already located over the conveyor 22 and that a signal is generated indicating that a pouch group is ready for removal on the conveyor 22 beneath it. In response to this signal the respective vacuum head assembly is lowered and then raised to pick up the pouch group, and the chains 86 are moved by a further one quarter turn to bring the pouch group over the conveyor 23. During this further quarter turn the associated carriage is moved in the downstream direction along its support 72^1, so that by the time the quarter turn has been completed it is ready to seek the most downstream empty tray pair which is available on the conveyor 23; this is in contrast with the arrangement previously described in relation to Fig. 10, in which the most upstream tray pair available is sought.

In seeking the most downstream empty tray pair available the carriage moves downstream to the end of its stroke and is then reversed until it senses the first empty tray pair available beneath it. The correlation of the carriage and this tray pair is indicated by a correlation signal generated when a light source on the tray pair in question activates a photocell in the vacuum head assembly 74^1 in the manner previously described in relation to Fig. 10. The light source of a tray pair which is already full of pouches is obscured by those pouches and so does not result in a correlation signal.

In response to a correlation signal generated in this way the reduced pressure supply to the vacuum head assembly is removed and the pouches held by the vacuum head assembly fall into the tray pair in question. The carriage is then automatically moved as necessary along its support 72^1 to bring the vacuum head assembly into transverse alignment with the group maker conveyor 22, so that when further movement of the chains 86 later brings the assembly in question again into longitudinal alignment with the conveyor 22 the assembly is already in position for picking up a pouch group as described above.

If desired, after location over the selected empty tray pair but prior to releasing the pouches into the tray pair the carriage 71 is momentarily reversed again in direction so as to move downstream in synchronism with the tray pair. This increases the accuracy with which the pouches fall into the tray pair, but it is hoped that the inclined

walls 77 at the front and back of each tray will provide a sufficient accuracy of location to make this further reversal unnecessary. To even further increase the accuracy of location, the momentary reversing movement of the carriage 71, if provided, may be accompanied by lowering of the vacuum head assembly 74.

Although in the described embodiment and the modification thereof the marshalling devices 16 and 17, the group maker 21, and the transfer device 70 or 70^1 are operatively associated with one another, this is not essential, and within the scope of the invention are apparatus which include only one or, at the most two, of those items. In addition, whereas in the described embodiment two marshalling stations 16, 17 are provided in series to combine four pouches streams into one, an apparatus in accordance with the invention may only comprise one marshalling station; using a more complicated programme than that described for the stations 16, 17 individually, this single marshalling station may be arranged to combine three or more pouch streams together.

The invention is not limited to apparatus for handling pouches as particularly described, but may have application to the handling of other objects, whether containers (filled or not) or otherwise.

WHAT WE CLAIM IS:—

1. A method of forming a single stream from articles moving randomly but at the same speed in a predetermined number of parallel streams greater than one, which comprises:

operating upon the articles within the streams so as to accelerate them in succession to a speed greater than the product of the said speed and the said number of streams and in such relative time relation as to provide at least a clearance between them longitudinally of their paths of advance, and forming the accelerated articles into a single stream by lateral movement across their paths of advance.

2. An article handling apparatus for forming a single stream from articles arriving randomly but at the same forward speed in a predetermined number of parallel streams greater than one, which comprises, for each incoming stream, an article advancing device operable to successively advance the articles in the stream to a speed greater than the product of the said forward speed and the said predetermined number of incoming streams, the advancing devices being arranged as a group in side-by-side relation across the paths of advance of the articles in the incoming streams, and the apparatus further including control means arranged for controlling the advancing devices individually but in such relative time relation that the articles leave the group of advancing devices separated longitudinally of their paths of advance at least by a clearance, conveyor means arranged for receiving the articles leaving the advancing devices and for transporting them away from the same, and marshalling means operable upon the articles when transported by the conveyor means so as by lateral movement to form the articles into a single stream.

3. A packaging system including article handling apparatus as claimed in claim 2, conveyor means disposed to receive articles from said handling apparatus and adapted to arrange the articles cyclically and in succession in a predetermined number of streams greater than one, and grouping apparatus disposed downstream of the conveyor means for forming regular groups from the articles discharged from the conveyor means, the grouping apparatus comprising, for each incoming stream, a gating device repetitively operable on receipt of the foremost article in the stream to advance the article to a predetermined stationary position on a respective first conveyor, the gating devices being arranged in side-by-side relation whereby successive lines, one for each cycle of article arrival, are formed on the first conveyors, the first conveyors being individually arranged, on operation of a predetermined one of the gating devices, to index articles thereon forward through one article pitch of the groups to be formed, the grouping apparatus further comprising a second conveyor having a capacity at least equal to a said group and arranged for receiving the articles from the article conveyors as said successive lines, the second conveyor being operable with the said predetermined one of the gating devices to index the lines forward through one said article pitch whereby said groups are formed in succession thereon.

4. A method of packaging articles moving randomly but at the same speed in a predetermined number of parallel incoming streams greater than one, comprising:

forming the articles into a single stream as claimed in claim 1;

distributing the articles of the single stream equally between a plurality of further streams moving at the same speed, forming transverse lines of the articles from the foremost articles in the further streams taken cyclically in succession, forming the articles into regular groups each comprised of a predetermined plurality of successive said lines, and packaging the groups individually in packages.

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Chartered Patent Agent.

Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1981.
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY,
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1587715 COMPLETE SPECIFICATION
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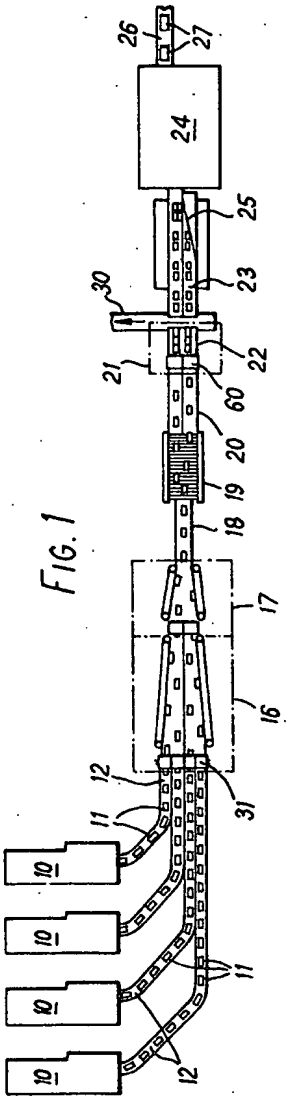

FIG. 1

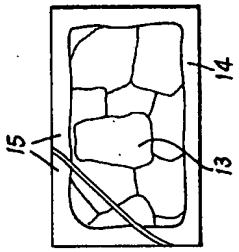

FIG. 2

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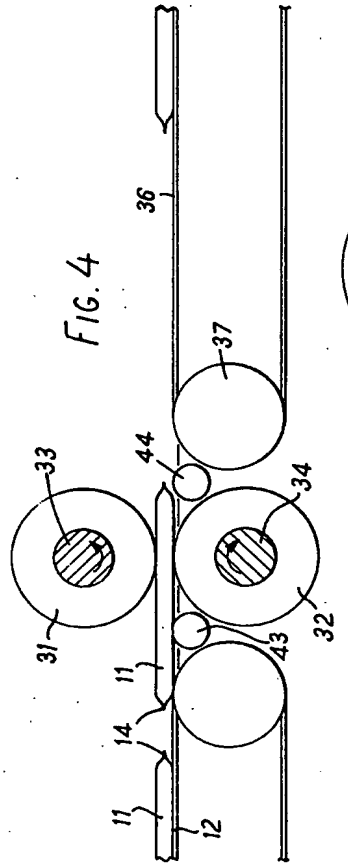

FIG. 4

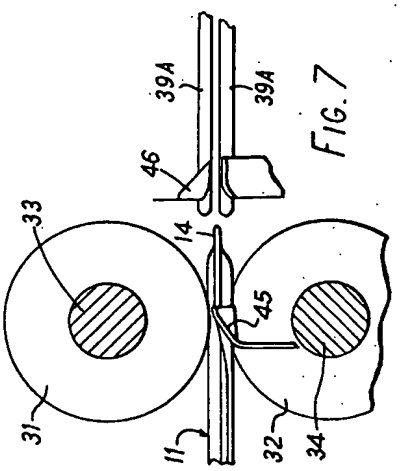

FIG. 7

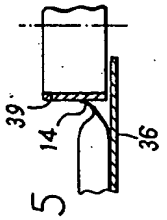

FIG. 5

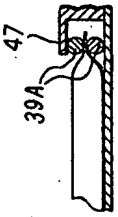

FIG. 6

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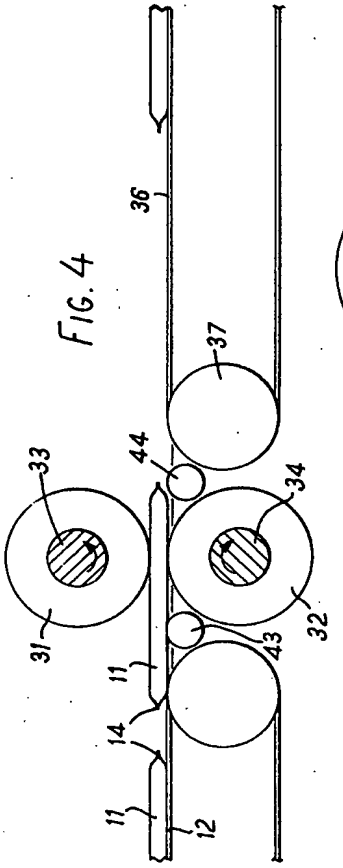

FIG. 4

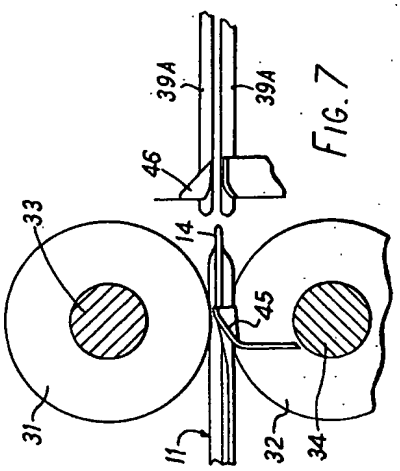

FIG. 7

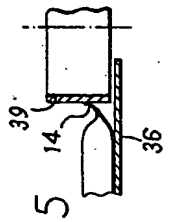

FIG. 5

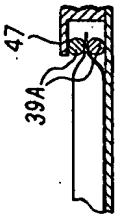

FIG. 6

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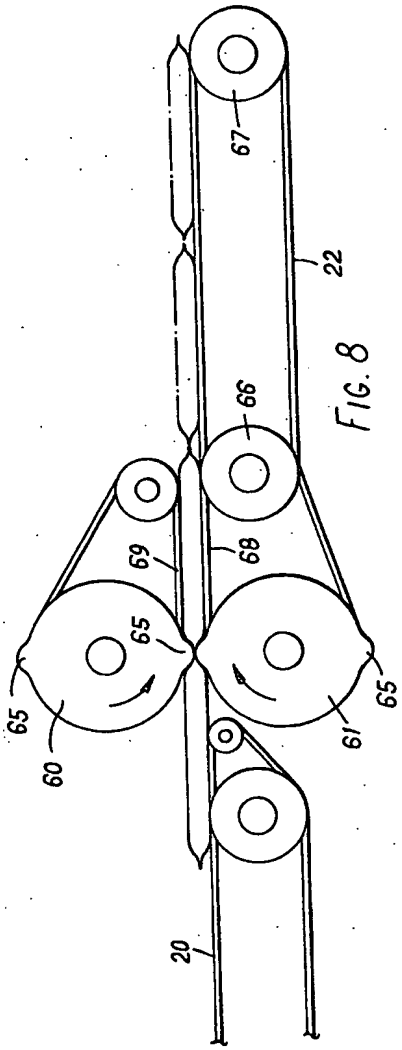

FIG. 8

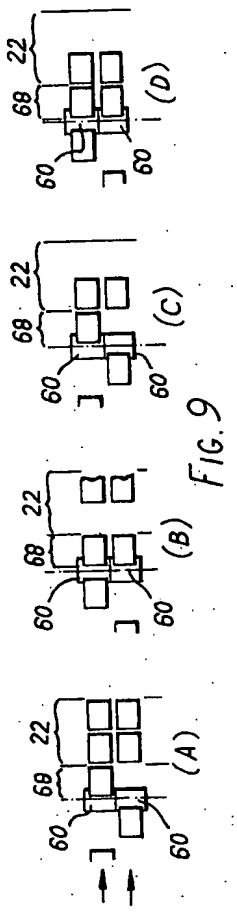

FIG. 9

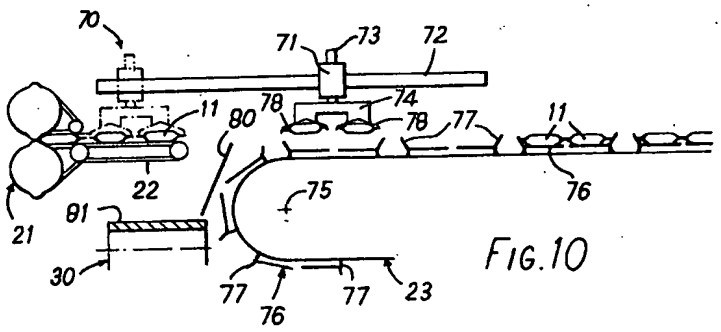

FIG.10

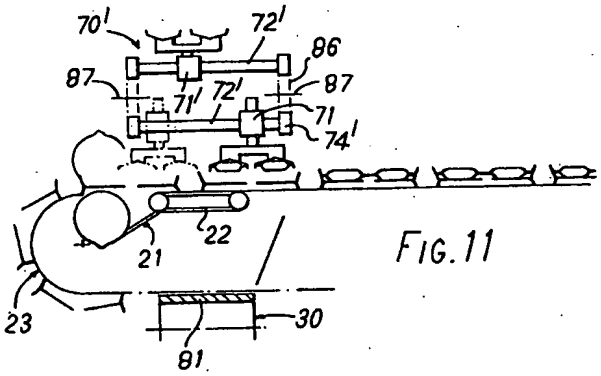

FIG.11

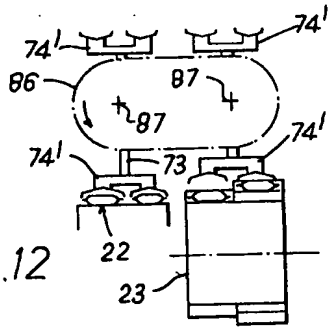

FIG.12